

obtain photographs, and it was not until the negatives were developed that all hope of having secured some traces of the corona and prominences were given up. As might be expected, the spectroscopic negatives of the narrow solar crescent show some of the chief lines of the spectrum, H and H_1 being easily recognised. The star-spectroscope, too, yielded a very fair spectrum, but it is merely that of daylight. Many negatives of partial phase were taken, but they only serve to show that the plates were in good order.

One circumstance may be mentioned as showing how near we were to one of the few spots where the eclipse was well seen. During totality I had noticed that the sky near the S.S.E. horizon, which was visible from my post, was quite clear, and tinged as if the sun were setting. A few days afterwards we learnt from the captain of the Volga steamer *Alaska*, which was then between Kineshma and Nischni Novgorod, that he had seen the whole of the total phase unimpeded by clouds. His position would about agree with the clear gap visible from Pogoste.

I cannot conclude without expressing my warmest thanks to Professor Bredichin for the hearty welcome which he and his whole family accorded to us in Russia.

Dun Echt Observatory :
1887, November 9.

The Total Solar Eclipse of August 19, 1887. By the Rev. S. J. Perry, F.R.S.

Although the clouds interfered most seriously with the observation of the solar eclipse on August 19, I feel it to be my duty, as a delegate of the Council, to lay before the Society a brief report of the manner in which their mission was carried out; and I trust that some at least of the details I am about to mention may not be found useless for future eclipse observers. Most of the Fellows will remember that our associate Professor Bredichin sent a very generous invitation to the Society, offering hospitality to any two of its members who might wish to observe the total eclipse, and that Dr. Copeland and myself had the honour of being nominated by the Council as the representatives of the Society.

The Astronomer Royal most kindly placed at my disposal the coronagraph and photo-spectroscopes used by Mr. Maunder in 1886; so I resolved at once to devote my whole attention to the photographic portion of our work. A full description of the instrument will be unnecessary. It will suffice to mention that two spectroscopes, with cameras attached, were fastened to the square tube of the coronagraph, and the same tube carried a

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4-inch achromatic and two small finders, one of which gave a projected image of any bright object that might be in the field of view of the telescope. I removed the 4-inch telescope, which I did not think I could use advantageously, and replaced it by a second coronagraph of somewhat shorter focus than the first. The two small finders were exceedingly useful, as one served for fixing accurately the position of the instrument, and the other for retaining the Sun in the centre of the field. The coronagraph, which is the joint property of the Royal Observatory and of the Royal Society, is most unfortunately very incomplete, and much time was necessarily lost in correspondence before all the essential parts could be got together. Besides the Royal Society and the Astronomer Royal, I have to thank General Festing and Captain Abney for the loan of a most valuable $4\frac{1}{2}$ -inch photo lens with camera and dark slides; Mr. Hilger for a 5-inch object-glass; Mr. Lockyer for a 2-inch photo lens; and Dr. Schuster for the tube of the second coronagraph. Having collected the parts I erected the instrument at Stonyhurst, strengthened the tripod stand, adapted it to the required latitude, and so arranged the two-prism spectroscope that a comparison spectrum might be taken on the same plate as the coronal lines. Mr. Maunder very kindly secured the same advantage for the one-prism spectroscope by a different arrangement; I shifted the camera and exposed different parts of the same plate, whilst he covered different parts of the slit. Experiments were then made with sensitised plates from different makers: the Ilford, Derby, Eclipse, and Isochromatic were those used. All gave good results. The Ilford plate I found most reliable for long exposures, and the Isochromatic was perhaps slightly more satisfactory for spectrum photography; but as I wished to make the photographic arrangements as simple as possible, I thought the Derby plate would suit me better altogether than any other. I therefore ordered a special set of quarter-plates to be prepared for the eclipse, the emulsion being identical with that used for the Greenwich dry plates, and I told the maker to back them carefully and to pack them in special boxes. Two dozen of these plates were cut into halves by my assistant for use in the spectrum cameras. With a narrow slit, and an exposure of one second, excellent spectra were obtained from clouds near the Sun, and an exposure as instantaneous as possible gave similar results with direct sunlight. The lunar spectrum required about two minutes for a strong picture, whilst the Moon itself was well photographed in half a second. Beach's developer was found to answer well for all purposes, and was carried already mixed in bottles, two bottles of each ingredient being taken in case of accident.

The instruments and chemicals were sent by steamer from Hull to St. Petersburg, Messrs. Wilson & Co. taking the greatest care in seeing them well stowed on board, and a letter from the Russian minister freeing them from all duty, and even

from examination on arrival at their destination. This letter was due in great measure to the forethought of Professor Struve, who took the greatest pains to smooth the way for the eclipse observers, and gave us a most hearty reception at his magnificent observatory at Pulkowa. Every assistance was rendered to us at St. Petersburg by Mr. Saunderson, and he also telegraphed to the directors of the Steamboat Company on the Volga to secure all facilities during our journey to Pogost. I have also to acknowledge the kindest attention from Sir R. Morier, British Ambassador at St. Petersburg, and from other members of the Embassy.

At Kineshma we were met by Professor Bredichin, who more than fulfilled the high expectations we had formed from the kindness already shown us in Russia. Pogost was placed entirely at our disposal, every comfort was supplied, and we enjoyed the precious advantage of being left entirely free to attend to our preparations, any number of workmen being near at hand to assist when needed. A fortnight was spent in mounting instruments, testing chemicals, and making final adjustments and arrangements. A very few things were damaged by the journey, and the watchmaker of Kineshma easily repaired the mischief. A Russian bath-house served excellently as a photographic hut, and we were well supplied with rain and spring water for washing our plates during the process of development. A large ice-house also formed part of the establishment, and would have been more useful had the temperature remained at the height we found it on arrival. Most fortunately we were joined a few days before the eclipse by Miss Brown, of the Liverpool Astronomical Society, and her cousin Miss Jeffreys, and the latter most obligingly and most efficiently took charge of the cameras of my spectroscopes during totality, thus leaving me entirely free to attend to the two coronagraphs. With the one-prism spectroscope I hoped to obtain on the same plate a spectrum of the corona and two solar spectra for comparison, and with the two-prism spectroscope I thought I might secure two spectra of the corona, one with, and the other without, a comparison spectrum on the same plate. I found by rehearsals that by giving undivided attention to the coronagraphs I could with a clear sky obtain easily during the $2^m\ 10^s$ of totality twelve photographs of the corona with the following exposures: four of 1^s , two of 2^s , two of 5^s , and one each of 20^s , 40^s , and 55^s . I was also prepared to expose plates in each instrument, so that the position of the Sun's axis might be determined by two pictures of the solar crescent on the same plate. For the same object two pointers were photographed on each negative.

The morning of the 19th, like most of the mornings that immediately preceded it, was cloudy, but the clouds were broken, and we thus obtained occasional glimpses of the solar crescent before totality, during one of which I exposed a plate; but clouds prevented a second picture being obtained on the same plate.

Seeing the nature of the sky I was forced at the last moment to alter my previous plan, and I resolved on trying only the short exposures of 1^s , 2^s , and 5^s . But even in this I was again disappointed, for during totality there was not even a partial break in the clouds, except at the last moment, and then I exposed a plate with as little delay as possible, but a minute arc of the photosphere had already appeared in the heavens. Had I exposed this plate for a somewhat longer time I might have obtained a slight trace of the corona, but it could scarcely have been of any practical utility. The negative shows a less bright extension of the photospheric arc, which must, I think, be due to a prominence of the chromosphere. Several pictures were taken whilst the solar crescent was still very narrow, and the diffused light is much stronger and more extended on the convex than on the concave side of the crescent, but this probably is due to the imperfect sky combined with the greater intensity of the convex arc rather than to any appearance of inner corona. In the second negative one of the cusps is decidedly sharp and the other blunt, and there is a marked difference in this respect in the successive pictures; but as the crescent became wider all bluntness disappeared. During totality the darkness was not great, the clouds possibly diminishing the effect. At any time I could have read the face of a watch without much difficulty, but lamps were ready in case of need.

The disappointment at so meagre a result would in any case have been great, but we felt it more intensely as we saw what distress it caused the hospitable family, who had done so much to ensure our perfect success. Personally I have to acknowledge my great obligations, not only to Professor Bredichin and his family, but also to Dr. Copeland and Mr. Macpherson for their generous aid during the time of preparation.